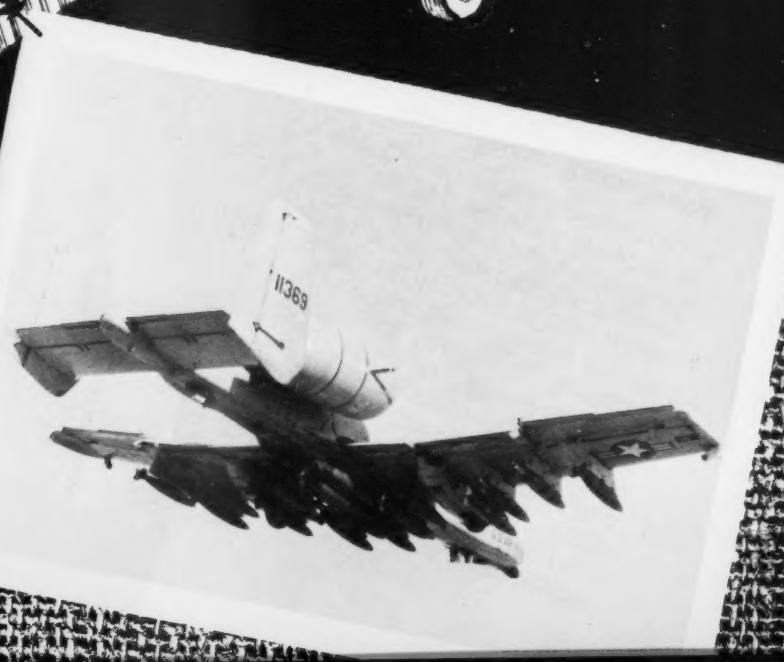
COMMANDERS DIGEST
VOL. 19, NO. 17/AUGUST 12, 1976

DESIGN to Cost



DESIGN to COST

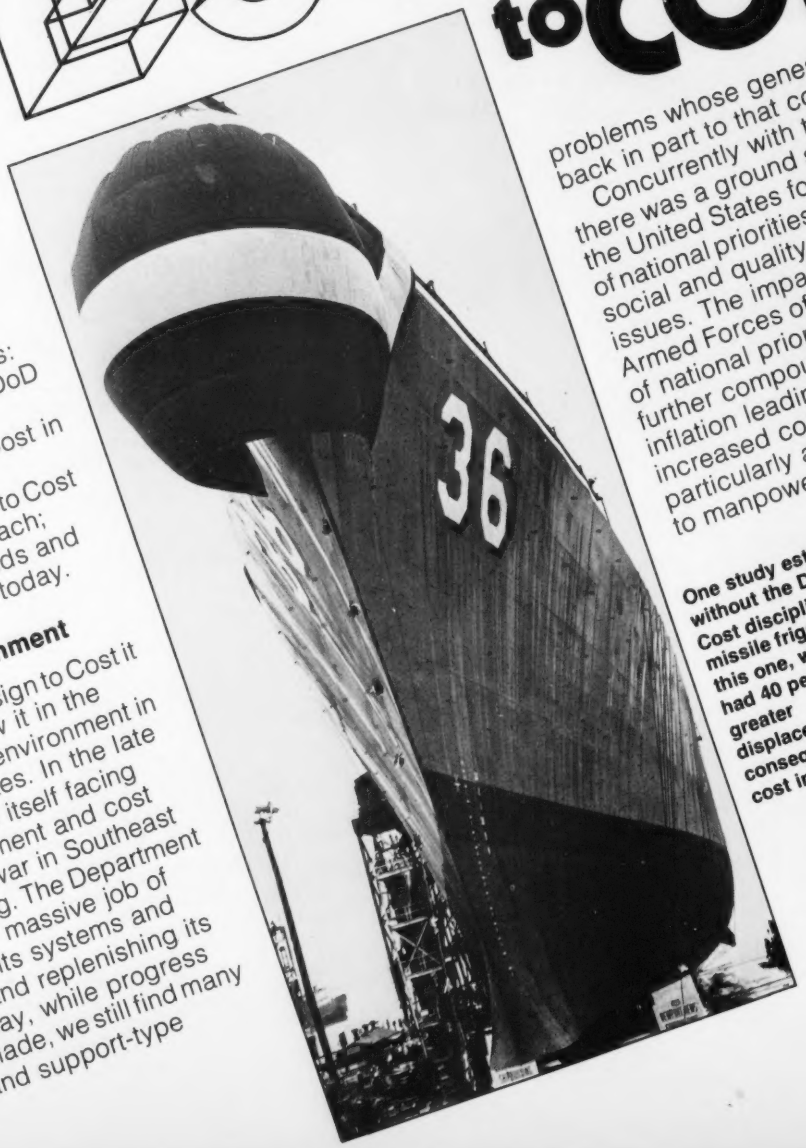
It is a pleasure to discuss Design to Cost in the Department of Defense. This subject has received a sizable amount of emphasis and publicity in the past several years. As background I'd like to discuss:

- The environment which DoD currently operates;
- The role of Design to Cost in this environment;
- The viability of Design to Cost as a management approach;
- Probable future trends and new initiatives as seen today.

Management Environment

To understand Design to Cost it is necessary to view it in the perspective of the environment in which DoD operates. In the late 1960s DoD found itself facing serious management and cost problems. The war in Southeast Asia was ending. The Department faced a rather massive job of modernizing its systems and equipment and replenishing its stocks. Today, while progress has been made, we still find many logistics and support-type problems whose genesis relates back in part to that conflict.

Concurrently with this period, there was a ground swell within the United States for a shifting of national priorities to address social and quality of life issues. The impact on the Armed Forces of the shifting of national priorities was further compounded by inflation leading to increased costs, particularly as it pertain to manpower costs.



One study estimated that without the Design to Cost discipline, the guided missile frigate, such as this one, would have had 40 per cent greater displacement, with consequent unit cost increase.

By DR. JOHN J. BENNETT
Deputy Assistant Secretary
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The fact is that today DoD has less real purchasing power to use in procuring or modifying its weapons and equipment; yet, there is a very long way to go to having the force equipped the way military advisors feel is necessary.

Make no mistake about it, this poses a real problem for the Services. Pieces of this problem continually make the news, whether it is the need for a B-1 aircraft or the cost of the all volunteer Army.

At about the same time the Southeast Asia war began phasing down, DoD found itself facing massive cost overruns on many of its major systems, such as the C5A aircraft. Senator William Proxmire characterized 1969 as the year of the cost overrun; Government Accounting Office (GAO) reported a $21 billion cost growth in 38 systems; and Congress demanded remedial action to reverse the trends in acquisition management.

Almost everywhere one looked at that time there were major system acquisition problems.

Many contractors were tied to total package procurement, a method now almost completely abandoned. Military planners had perhaps been over-demanding in stating their requirements and somewhat over-optimistic in accepting estimates to meet these demands.

From this array of problems one could pick many that influenced or had a bearing on DoD's adopting a Design to Cost approach. Two stand out in my mind—spiraling costs and lack of good engineering cost management.

In 1971, Senator John Stennis summarized the DoD spiraling cost problem in saying, "If the geometric cost increase for weapon systems is not sharply reversed, then even significant increases in the defense budget may not insure the force levels for our national security." This was a challenge sounded from the highest level of government. In essence, DoD was beginning to price itself out of the market.

The second problem focused at the operating level. Because of extreme emphasis on technical advancement, the engineering process involved in defense acquisitions had more often than not inhibited or failed to encourage the use of the cost management facet of engineering to the benefit of the Department of Defense. Technical enhancement and excellence prevailed at the expense of cost, and it would be necessary to bring a better balance between these factors.

From 1969 to 1971 many changes were made in the way DoD managed its acquisition business. From 1972 on, many refinements have been implemented to increase further DoD's management effectiveness. Today, we believe that our acquisition policies are fundamentally sound. We can, however, expect continued fine tuning in the future as we constantly seek the right mixture of authority, flexibility and control. Two policies stand out that one should be aware of when examining DoD's Design to Cost approaches. These are the basics of DoD Directive 5000.1, "Major System Acquisition," and the high/low mix policy.

DoD Directive 5000.1, "Acquisition of Major Defense Systems," published in July 1971, is the cornerstone of our efforts to improve acquisition management. This Directive formalized many changes made in DoD's management process:

- It raised the stature and authority of DoD program managers.
- It broke the acquisition process into incremental steps and required demonstrated

ABOUT THE COVER: The photo and diagram are of the Air Force A-10 aircraft.

achievement of objective prior to initiation of the next program phase.

- It specified "design to" requirements for production and support costs, with tradeoffs between performance, cost, and schedule.

DoD's high/low mix policy addresses the problem cited by Senator Stennis—the need to restrict continued unit cost growth from generation to generation in order to maintain future forces in the same quantities as today's levels. This policy has resulted in the initiation of a number of less sophisticated and complex weapon systems—with the specific objective of quantity production. The 600-ship Navy is a classic example of high performance versus adequate quantities of equipment.

Role of Design to Cost

Design to Cost is one of the ways DoD is implementing elements of Directive 5000.1 and the high/low mix policy. As such, it is a blend of a philosophy, a set of policies and practices, and a system of procedures and techniques.

As a philosophy, it represents an attitude, a frame of mind, a way of thinking about the cost problem to bring about better cost management at every level of DoD and the defense industry. It is a concerted effort to bring about integration of our engineering and cost management to force a coherent approach to the downstream cost issue at the time of design. As such, it represents significant cultural change for DoD technical management people.

As a policy and practice, it is a tool to limit cost uncertainty and the demand on production funds. It is a goal-setting device which motivates the dovetailing of engineering creativity to price, and makes cost a primary variable in the design process. It strengthens and underscores the project manager's role and responsibility for sound cost management at the DoD and contractor level.

Procedurally, Design to Cost is delineated for implementation through a series of DoD and Service instructions beginning with DoD Directive 5000.28, "Design to Cost." Additional guidance is covered in the *Joint Logistic Commanders Guide* and other documents. Its implementation takes place largely through various contractual instruments.

Viability of Design to Cost

Answering the question of whether Design to Cost is working is like asking whether your deodorant is working. It depends on what your outlook is and where you stand. But some general measurements and judgments can be made.

Cost consciousness throughout every facet of the government and industry team, in my opinion, has never been higher. While this doesn't mean that there is not room for further improvement, it does seem to indicate that Design to Cost as a philosophy is taking hold. We see this attitude toward cost in Defense Systems Acquisition Review Councils (DSARCs), in the cultural changes taking place in engineering education, and in numerous management decisions made on individual programs where cost obviously has more priority than in the past.

Conceptually, from a policy standpoint, there is little doubt that Design to Cost, properly executed, can improve our cost management. We know, for example, that:

- Requirements and design decisions are major drivers of future costs.
- Unit production cost visibility can influence costs. Such visibility was not available in the past.
- The first workable design is not necessarily the most cost effective design.
- The last few per cent of a performance increase may mean a major cost increase due to the need for higher technology.

The opportunity for improved cost management obviously exists. The problem, therefore, is one of execution.

Cost growth, while difficult to judge, seems to be decreasing in terms of several general measures. The A-10, F-16, F-18, aircraft and the guided missile frigate (FFG) are all low examples of the high/low mix policy. **Figure 1** shows growth rates from generation to generation for fighter aircraft. The introduction of the

F-16 and F-18 has reduced annual growth rate in replacement fighter aircraft from 9.2 per cent to 5.3 per cent.

The FFG is another illustration. Without the Design to Cost discipline, one study estimated that this ship would have had 40 per cent greater displacement, with consequent unit cost increase. Introducing such low mix systems will enable us to maintain future force levels in the same quantities as today's.

A second measure from a top management viewpoint is the general trend in program cost growth from the development estimate. **Figure 2** shows the results of an analysis of such growth in programs reported in the Selected Acquisition Report (SAR). The annual growth rate in constant base year dollars of 6.4 per cent in December 1972 was reduced to 4 per cent in March 1975. This amounts to about a 30 per cent improvement, and represents sizable sums when spread over the life of major programs.

A third measure is how well DoD does in regard to its Design to Cost goals. Of the 24 major programs which now have firm Design to Cost goals, 19 are still in development. For these the targets have remained unchanged. Several of the programs which have reached production have some growth. Two are in the 10 per cent range. Two others are currently held to limited production while major cost reduction efforts are conducted. Some of the factors which have caused growth have been goals imposed late in development, changed requirements without comparable increase in goals, and program stretchout beyond

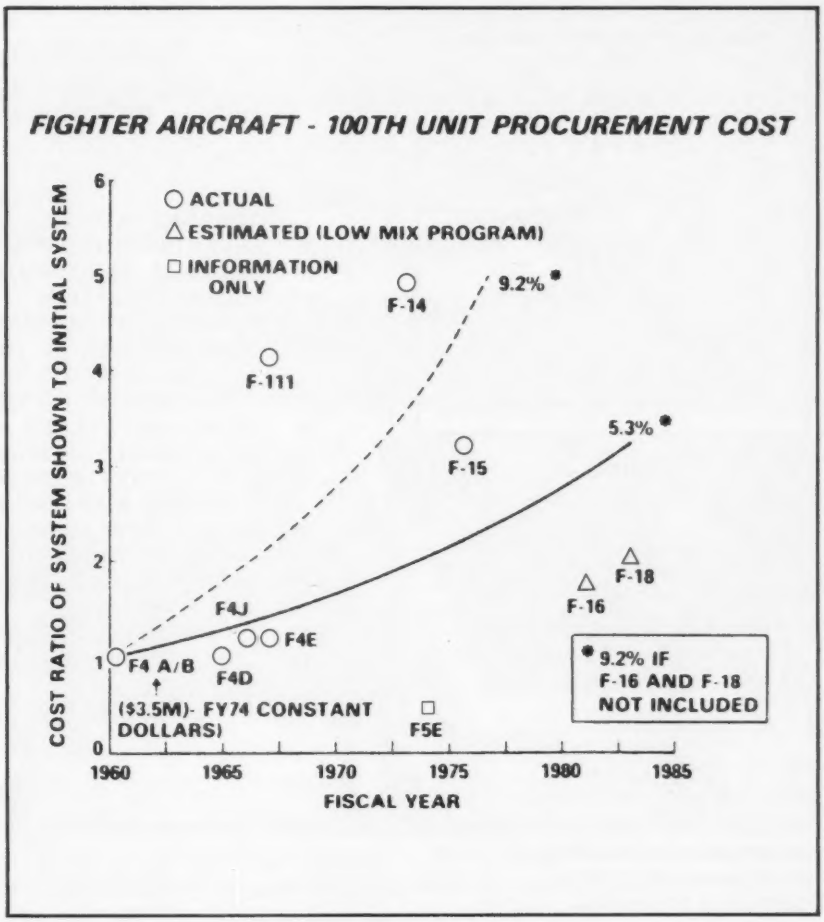

Figure 1

Service control. DoD's decision to restrict production on the two systems is clear evidence that such growth is a matter of serious concern.

Another way of judging DoD's progress in the cost management is to compare DoD's performance with how others who manage major programs are doing. Last February GAO published data which would allow gross government interagency

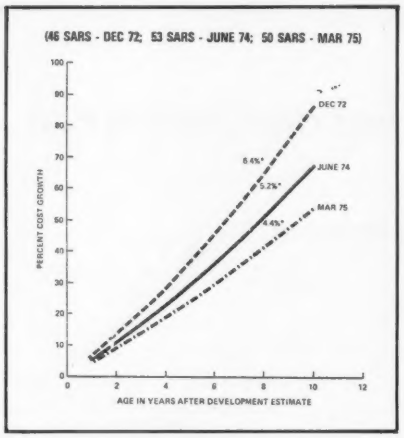

Figure 2

comparison of management performance from the viewpoint of cost.

Figure 3 shows that overall DoD growth has generally been substantially below civilian projects.

While these facts, illustrated in Figure 3, are generally encouraging, our feedback from industry and our own surveys indicate we have a long way to go to implement fully Design to Cost principles in our Request for Proposals and in administration of the contracts.

Looking to the Future

From my experience, major changes in management philosophies and approaches in DoD systems acquisition management take about 10 years and go through several stages of research maturity if they are to prove valid. We are about five years into this cycle and are just starting to see Design to Cost settle in as a standard operating procedure. This means that we are probably well into the first round of implementation, having learned much and, having begun to fine tune our practices and our procedures. You can see this happening wherever you turn. For example:

- An updated *Joint Logistics Commander (JLC) Guide* will be available shortly.
- Design to Cost training is being sponsored by the Services for engineering and procurement personnel.
- *Armed Services Procurement Regulation (ASPR)* Design to Cost coverage has been approved and will be published shortly.
- The new source selection directive recently published provides for contractor Request for Proposal (RFP) inputs of potential cost reduction ideas, with appropriate recognition for contractors whose ideas are adopted.
- The contract cost reduction change issue has been

COST GROWTH RECORD
GAO REPORT AS OF JUNE 30, 1975
PUBLISHED FEB. 27, 1976

RANK	AGENCY	PER CENT COST GROWTH
1	GENERAL SERVICES ADMINISTRATION	13
2	ENVIRONMENTAL PROTECTION AGENCY	14
3	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	17
4	DEPARTMENT OF DEFENSE (TOTAL)	33
	DEPARTMENT OF THE ARMY	28
	DEPARTMENT OF THE NAVY	28
	DEPARTMENT OF THE AIR FORCE	44
5	TENNESSEE VALLEY AUTHORITY	34
6	DEPARTMENT OF INTERIOR	46
7	WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY	86
8	ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION	88
9	CORPS OF ENGINEERS (CIVIL WORKS)	96
10	DEPARTMENT OF TRANSPORTATION	159
11	APPALACHIAN REGIONAL COMMISSION	321

AGENCIES REPORTING OVER $1B ACQUISITION

Figure 3

addressed in several policy memos. ASPR coverage is now under consideration.

• We have a variety of initiatives underway on the specification problem to reduce their inappropriate use, and hence, generation of unnecessary cost.

Probably the most important new initiatives are in the Operating and Support (O&S) cost area. DoD Directive 5000.28, issued May 23, 1975, focused attention on the need to make weapon system design decisions based on life cycle cost impact (this is both procurement cost and O&S cost). Weapons system managers were enjoined to establish O&S costs goals in order to manage life cycle costs, and to demonstrate achievement of these goals through such O&S cost surrogates as reliability, maintainability and maintenance manpower.

More recently, Deputy Secretary of Defense William P. Clements' policy memorandum to the Services on "Reduction of Outyear Operating and Support Cost" set an objective of reduction of the fraction of outyear budget allocated to O&S costs through the exercise of O&S cost management. Weapon system decisions will be based on O&S cost considerations. A planning system will be established to manage the O&S cost reductions.

Weapons system support costs visibility is being developed under the Visibility and Management of Operating and Support Costs (VAMOSC) task group. The VAMOSC effort is identified as a major OASD (I&L) management objective. The VAMOSC data will track DSARC predictions.

Cost growth, while difficult to judge, seems to be decreasing in terms of several general measures. The Air Force's F-16 (top) and A-10 (bottom views) are both low examples of the high/low mix policy.

O&S cost guides have been provided to the Services as a framework for weapon O&S cost projection. At DSARC, milestones O&S costs are assessed not only by the Services but also independently by the OSD Cost Analysis Improvement Group (CAIG). This structured approach is providing better visibility of O&S costs.

Most important, we are starting to see some emphasis on managing O&S cost on some of the new systems such as F-16, F-18, and Utility Tactical Transport System (UTTAS).

The guided missile frigate, such as this one from which a Harpoon missile is being fired, is another low example of the high/low mix policy.

The key O&S cost management issues are still ahead of us. How do we predict and establish difficult but achievable O&S cost goals for weapon systems? Some important considerations are:

- How early in the development phase can the O&S cost be predicted?
- How much uncertainty can we accept in the O&S cost prediction?
- What methodology should be used? Does the methodology require too much detailed data? Is available detail being used?
- Can we establish relationships between O&S costs and design which provide the visibility to make design and logistic tradeoffs?

To support the establishment of O&S cost goals, the O&S cost estimating process needs significant improvement. We cannot simply afford to extrapolate the O&S costs from current systems and apply them to new systems without a searching and critical examination of the factors which have driven these costs.

In particular, we want to reduce manpower costs. An understanding should be developed of the interactions between Service policy, readiness, manpower skill level distribution, and weapon reliability and maintainability. Manpower goals can then be systematically established to minimize O&S costs while maintaining readiness. We are starting to establish manpower goals as part of the management process. However, we need significantly improved methodology and data to really work this problem.

While we are well into Design to Cost application, we are just now beginning to well understand and to solve many of the O&S cost aspects of the problem.

Summary

In closing, national security and national defense are intimately related to a strong U.S. economic condition and a healthy U.S. economy. National security and national defense rest equally on national productivity and our ability to compete as well as a strong and viable technology and production base. When we make technical and cost management improvements in our developments, although they may seem inconsequential, we are strengthening our economy, our security and our defense. This kind of teamwork has made the United States strong. Stringent use of resources will be a major defense issue for the foreseeable future. Application of Design to Cost is one key to using these resources more economically and efficiently.

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Vol. 19, No. 17, August 12, 1976

A publication of the Department of Defense to provide official and professional information to commanders and key personnel on matters related to Defense policies, programs and interests, and to create better understanding and teamwork within the Department of Defense.

Published bi-weekly by the American Forces Press Service, 1117 N. 19th St., Arlington, Va. 22209, a unified activity of the Office of Information for the Armed Forces, OASD (PA).

Telephone: (202) OXford 4-5070
Autovon 224-5070

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
Subscription Price: $17.00 domestic per year; $4.00 additional for foreign mailing; 65 cents per single copy.
☆ U.S. GOVERNMENT PRINTING OFFICE 211/337/T-50